

## What Is the Prevalence of Senior-athlete Rotator Cuff Injuries and Are They Associated With Pain and Dysfunction?

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### Abstract

**Background** Older individuals with rotator cuff injuries may have difficulties not only with activities of daily living, but also with sports activities.

**Questions/purposes** (1) How frequent and severe are rotator cuff abnormalities, as identified by ultrasound, in senior athletes? (2) To what degree does the severity of ultrasound-identified rotator cuff pathology correlate with pain and shoulder dysfunction?

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Each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at the Summer National Senior Games, Pittsburgh, PA, USA.

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**Methods** We assessed pain and shoulder function in 141 elite athletes older than 60 years of age (median age, 70 years; range 60–84) at the Senior Olympics who volunteered to participate. An ultrasound evaluation of the rotator cuff of the dominant shoulder was performed by an experienced musculoskeletal radiologist in all of these elite athletes. We then determined the relationship between ultrasound findings and shoulder pain and shoulder function as assessed with the Disabilities of the Arm, Shoulder and Hand (DASH) and American Shoulder and Elbow Surgeons (ASES) scores.

**Results** There were 20 shoulders with a normal cuff (14.2% [20 of 141], of which 5% [one of 20] were painful), 23 with tendinosis (16.3% [23 of 141], of which 30% [six of 20] were painful), 68 with a partial-thickness rotator cuff tear (48.2% [68 of 141], of which 32% [20 of 63] were painful), and 30 with a full-thickness rotator cuff tear (21.3% [30 of 141], of which 25% [seven of 28] were painful). Only 5% of athletes (one of 20) with a normal cuff on ultrasound evaluation reported shoulder pain, whereas 30% of athletes (33 of 111) with any degree of rotator cuff damage on ultrasound evaluation reported shoulder pain. This resulted in an odds ratio of 8.0 (95% confidence interval, 1.0–62.5). The proportion of patients who had pain was not different in those with different severities of rotator cuff pathology. Neither the ASES nor the DASH was different in those with different severities.

**Conclusions** The frequency of full-thickness rotator cuff tears in senior athletes was 21.3% (30 of 141). Pain was a predictor of rotator cuff injury but not of its severity. The odds of having shoulder pain was eight times greater in those athletes with any rotator cuff damage as compared with those without any rotator cuff damage. Those with pain had poorer shoulder function but the ASES and DASH were poor predictors of the severity of rotator cuff

pathology. Rotator cuff tears in older individuals are often not painful and may not need to be repaired for successful participation in athletics.

*Level of Evidence* Level II, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

## Introduction

Rotator cuff injuries are among the most common of musculoskeletal maladies [4, 6, 9, 17]. Classic symptoms of a rotator cuff tear include pain, weakness, and loss of shoulder ROM. When a patient presents to the clinician with these symptoms, the best course of treatment depends on many factors, including (1) patient factors such as age, comorbidities, expectations, employment, workers compensation, activity, strength, tobacco use, and hand dominance; (2) anatomic factors related to the tendon, including the size of the tear, retraction, pattern, etiology (traumatic or atraumatic), chronicity of the tear, and the likelihood of the tear getting worse over time; (3) muscle-related factors such as atrophy and fat accumulation; and lastly (4) glenohumeral joint concerns like the condition of the articular cartilage and position of the humeral head on the glenoid. Difficulty in sorting out these many factors has resulted in little consensus for treatment of rotator cuff tears [20] and substantial geographic variations in surgery rates [30]. Treatment decisions are further complicated by the fact that rotator cuff injury may not even be the reason for the shoulder complaints; cervical spine pathology, acromioclavicular joint abnormalities, arthritis, and adhesive capsulitis all may confuse the clinical picture.

In older patients, rotator cuff tears are known to be common and can be asymptomatic. Both cadaveric and imaging studies have found full-thickness rotator cuff tears in approximately 25% of individuals older than 60 years of age [7, 10, 14, 21, 23, 24, 29]. Most are asymptomatic [23] and remain asymptomatic for several years or longer [12, 32]. As older individuals have become more active, clinicians are increasingly seeing patients with rotator cuff pathology whose difficulties are not limited to restrictions on activities of daily living, but also affect patients' athletic activities. These include activities of daily living and more strenuous activities such as sports. However, the frequency of asymptomatic rotator cuff pathology in senior athletes is unknown, and the degree to which rotator cuff pathology might be associated with pain or shoulder dysfunction in this population has, to our knowledge, not been described.

Both retrospective [1] and prospective [11] studies have reported nonoperative treatments of symptomatic full-thickness rotator cuff tears to be successful in up to 90% of

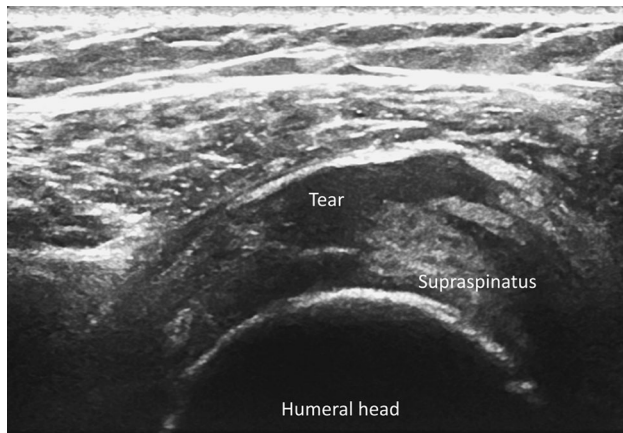
patients. Although some surgeons offer nonoperative treatments for their older patients with a rotator cuff tear [8], others recommend surgery because of concern that the rotator cuff tear can worsen [12] and shoulder function can deteriorate over time [13]. To determine if seniors can participate in elite sports with rotator cuff injury and to determine the frequency of rotator cuff injuries in senior athletes and the associations with shoulder pain, shoulder function, and severity of injury, we studied participants in the Summer National Senior Games colloquially known as the Senior Olympics. Specifically, we sought to determine: (1) How frequent and severe are rotator cuff abnormalities, as identified by ultrasound, in senior athletes? (2) To what degree does the severity of ultrasound-identified rotator cuff pathology correlate with pain and shoulder dysfunction?

## Patients and Methods

After institutional review board approval and permission from the Summer National Senior Games was obtained, we invited athletes at the 2005 Senior Olympics to take part in this research study. To advertise the study, we included an announcement in the athletes' registration packet, set up a research study information table, and posted flyers in the common area of the Peterson Event Center in Pittsburgh, PA, USA, the central venue of the Senior Olympics. Participation in the study took approximately 60 minutes and included both physical and ultrasound examinations of the shoulder as well as self-assessment questionnaires. Subjects were neither charged for procedures nor reimbursed for study participation.

There were 141 athletes who consented to do so and met the study inclusion criteria. The inclusion criteria were being a participant of the Senior Olympics and being older than 60 years of age and exclusion criteria were there being a history of fracture, osteoarthritis, or shoulder surgery.

We assessed pain with the visual analog scale (VAS) in response to the question "How bad is your pain today?" We also assessed shoulder function with the American Shoulder and Elbow Surgeons (ASES) and the Disabilities of the Arm, Shoulder and Hand (DASH) health scores. These were administered to the athletes with written instructions and one of us was present to answer questions about these self-assessment questionnaires. Despite this, not all of the athletes completed all portions of the questionnaires. If a portion of the questionnaire was incomplete, it was not included in our analysis. A musculoskeletal radiologist (AP) with 8 years of experience in shoulder sonography performed all ultrasound evaluations (General Electric, Fairfield, CT, USA; Logic 9 with 10 and 12-MHz transducers) on the dominant shoulder and classified the rotator cuff as prior described [2, 22, 31]. Ultrasound has



**Fig. 1** This is a transverse image of the supraspinatus with a full-thickness tear communicating with the subacromial, subdeltoid bursa above it. A strand of debris is noted at the tear.

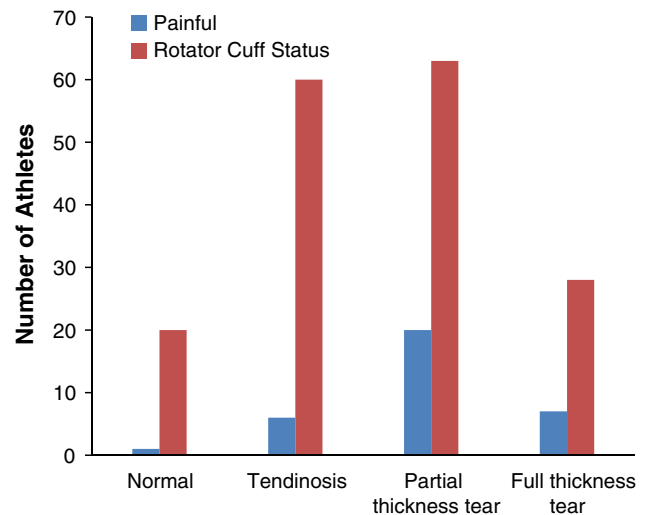
been shown to be effective in the diagnosis of rotator cuff disease [18, 26, 27].

We compared the frequency of tears and severity of pain between those with rotator cuffs classified as (1) normal; (2) tendinosis; (3) partial-thickness tear; or (4) full-thickness tear (Fig. 1). We also compared ASES and DASH scores between the painless and painful shoulders. Researchers who administered the questionnaires were blinded to the ultrasound evaluation and vice versa. The VAS that was scaled from 0 to 100 mm and all responses less than 20 mm were deemed to be painless.

Statistical analysis was performed with t-tests, chi square tests, and Fisher’s exact test as appropriate with 0.05 set as the level of significance.

**Results**

Age and sex were available on 132 athletes and the average age was 70 years (range 60–84). There were 58 men and 74 women. Ultrasound examinations were performed on 141 shoulders and VAS for pain was completed on 131 athletes. There were 20 shoulders with a normal cuff (14.2% [20 of 141]), of which 5% (one of 20) was painful, 23 with tendinosis (16.3% [23 of 141]), of which 30% (six of 20) were painful, 68 with a partial-thickness tear (48.2% [68 of 141]), of which 32% (20 of 63) were painful, and 30 with a full-thickness rotator cuff tear (21.3% [30 of 141]), of which 25% (seven of 28) were painful (Fig. 2). Five of the full-thickness rotator cuff tears involved more than one tendon. Five percent of athletes (one of 20) with a normal rotator cuff had shoulder pain, whereas 30% of athletes (33 of 111) with any degree of rotator cuff damage reported shoulder pain. This resulted in an odds ratio of 8.0 (95% confidence interval, 1.0–62.5).



**Fig. 2** This shows the number of normal and each type of rotator cuff injury and the percentage of each that is painful.

However, pain was not an indicator of severity of injury because the proportion of patients with pain was similar in those with tendinosis, partial-thickness cuff tears, and full-thickness cuff tears ( $p > 0.05$ ). ASES and DASH scores were available on 131 athletes. Neither the ASES nor the DASH was different in comparison of those with tendinosis, partial-thickness cuff tears, or full-thickness cuff tears ( $p > 0.05$ ). In the painless shoulders, the DASH was  $4 \pm 4$  for the normal shoulders,  $6 \pm 7$  for those with tendinosis,  $6 \pm 6$  for those with partial-thickness cuff tears, and  $9 \pm 9$  for those with full-thickness cuff tears. In the painful shoulders, the DASH was 27 for the normal shoulder,  $45 \pm 16$  for those with tendinosis,  $39 \pm 15$  for those with partial-thickness cuff tears, and  $49 \pm 23$  for those with full-thickness cuff tears. In the painless shoulders, the ASES was  $96 \pm 5$  for the normal shoulders,  $95 \pm 8$  for those with tendinosis,  $95 \pm 7$  for those with partial-thickness cuff tears, and  $93 \pm 9$  for those with full-thickness cuff tears. In the painful shoulders, the DASH was 78 for the normal shoulder,  $71 \pm 14$  for those with tendinosis,  $68 \pm 12$  for those with partial-thickness cuff tears, and  $57 \pm 15$  for those with full-thickness cuff tears (Table 1). Painful shoulders had an ASES score of  $69 \pm 12$  and a DASH score of  $17 \pm 13$ , worse than those with painless shoulders, ASES of  $95 \pm 7$  and DASH of  $6 \pm 6$ , respectively ( $p < 0.0001$  for each).

**Discussion**

Older individuals have become more active in sports, and so patients presenting for care are doing not merely for limitations on activities of daily living, but with goals that include return to sport. To guide this process, clinicians

**Table 1.** VAS, DASH, and ASES scores for the normal rotator cuff and each type of injury

Painless				
Type of rotator cuff injury	Number of athletes	VAS $\pm$ SD	DASH $\pm$ SD	ASES $\pm$ SD
Normal	19	5 $\pm$ 7	4 $\pm$ 4	96 $\pm$ 5
Tendinosis	14	4 $\pm$ 56	6 $\pm$ 7	95 $\pm$ 8
Partial-thickness	43	6 $\pm$ 8	6 $\pm$ 6	95 $\pm$ 7
Full-thickness	21	4 $\pm$ 6	9 $\pm$ 9	93 $\pm$ 9
All	97	5 $\pm$ 7	6 $\pm$ 7	95 $\pm$ 7
Painful				
Normal	1	27	10	78
Tendinosis	6	45 $\pm$ 16	12 $\pm$ 10	71 $\pm$ 14
Partial-thickness	20	39 $\pm$ 15	19 $\pm$ 13	68 $\pm$ 12
Full-thickness	7	49 $\pm$ 23	24 $\pm$ 8	57 $\pm$ 15
All	34	42 $\pm$ 17	19 $\pm$ 13	66 $\pm$ 14

VAS = visual analog scale; DASH = Disabilities of the Arm, Shoulder and Hand; ASES = American Shoulder and Elbow Surgeons.

need information about which kinds of rotator cuff pathology should be treated to maximize the likelihood that senior athletes will be able to remain involved in their chosen sporting pursuits. Because rotator cuff pathology is known to be common in the general population older than 60 years of age, we were interested in studying the frequency of these tears in senior athletes of similar age. We were also interested in whether rotator cuff pathology caused pain and dysfunction in this population.

A limitation of our study is that our volunteers may not have been representative of the athletes participating in the Senior Olympics. A small percentage of the thousands of Senior Olympics athletes participated in our study. There may have been a selection bias in that those with shoulder pain may have been more likely to participate in exchange for the evaluation we provided; this may have led to a higher apparent frequency of injury. Unlike the International Olympics, participants of the US Senior Olympics are often present in the host city only during their events so we strived to be available when the most athletes were in Pittsburgh. However, we were able to evaluate only a few athletes each hour and undoubtedly some athletes who wished to participate could not. Not all of the athletes completed all the information in the self-assessment questionnaires so we reported different numbers of participants in different portions of the study. Finally, we did not evaluate the sensitivity of ultrasound in the diagnosis of rotator cuff tears against another modality (such as MRI in this series); however, all evaluations were performed by a musculoskeletal radiologist with 8 years of experience in shoulder sonography, and numerous studies have found

ultrasound to be effective in the diagnosis of rotator cuff disease [18, 26, 27].

Rotator cuff tears in older individuals are often not painful and may not need to be repaired for successful participation in athletics. This is true whether the injury is tendinosis, a partial-thickness rotator cuff tear, or a full-thickness rotator cuff tear. Although ours is the first study to report the frequency of rotator cuff injuries in athletes, our results are similar to those of others who studied the frequency of rotator cuff injuries in the general population. We found full-thickness rotator cuff tears in 21.3% (30 of 141) of athletes older than 60 years of age. In the general population, full-thickness rotator cuff tears were found in approximately 25% of asymptomatic individuals older than 60 years of age [14, 24, 29]. Minagawa and coworkers [15] found rotator cuff tears increase with age being 15.2% in the 60s, 26.5% in the 70s, and 36.6% in the 80s. We found that 48.2% (68 of 141) of senior athletes older than 60 years of age had partial-thickness rotator cuff tears, which was greater than that found in same-aged individuals in the general population. Studies by both Sher and coworkers and Milgrom and coworkers [14, 24] reported only approximately 25% of asymptomatic individuals older than 60 years of age had a partial-thickness rotator cuff tear. We were somewhat surprised by the severity of rotator cuff pathology we identified in this report; we suspect these athletes had learned to cope with their rotator cuff injury enabling them to succeed throughout the many qualifying rounds of the Senior Olympics.

Most prior studies of the frequency of rotator cuff tears of the general population segregated individuals into asymptomatic [3, 14, 25, 29] and symptomatic groups [5, 19, 28]. In our study, we did not assume subjects were asymptomatic and instead, we assessed pain in each of our subjects with a quantitative measure. Because we did not assume that the participants were asymptomatic, we found that pain was a good predictor of rotator cuff injury in our senior athletes. Only 5% (one of 20) patients with a normal rotator cuff had pain, less frequent than any of those with a rotator cuff injury. Most of the senior athletes with rotator cuff pathology are asymptomatic and other senior athletes with rotator cuff pathology are coping with their pain, yet all are able to participate at an elite level. Our results are not unlike those found in the general population. Yamamoto and coworkers [33] found in 283 shoulders with a rotator cuff tear in 211 residents of a mountain village in Japan who were screened with ultrasound, 65% of them had symptoms with activities of daily living. However, pain was a poor predictor of the severity of rotator cuff injury. This may have been attributable in part to the lack of severe rotator cuff tears in the senior athletes. Of the injuries studied, 136 of the 141 were mild in severity being tendinosis, partial-thickness, or single-tendon, full-thickness

rotator cuff tears. If there had been greater numbers of large and massive tears, results may have been different. Like pain, the ASES and DASH scores did not correlate with severity of rotator cuff injury. Others have assessed how often a group of asymptomatic individuals with a rotator cuff tear remained so over time and found a large percentage remained asymptomatic over several years [12, 16, 32]. Specifically, in a study of 195 individuals with full- and partial-thickness rotator cuff tears followed for 2 years, 77% remained asymptomatic [12]. We believe more work needs to be done studying the proportion of patients with symptoms in different populations of individuals.

In conclusion, the frequency of full-thickness rotator cuff tears in senior athletes was 21.3% (30 of 141), which is similar to same-aged individuals of the general population [7, 10, 14, 21, 23, 24, 29]. Partial-thickness tears are more common in senior athletes than the general population [14, 24]. Pain was a good predictor of rotator cuff injury but was a poor predictor of its severity. Athletes with pain had poorer shoulder function, but the ASES and DASH were poor predictors of the severity of rotator cuff injury in senior athletes. A senior athlete presenting to a clinician with shoulder pain may have an etiology other than their rotator cuff tear because tears are not uncommon in these athletes and many of the tears are asymptomatic. Rotator cuff tears in some older individuals do not need to be repaired for successful participation in athletics because some tears are not painful and in those that are, some of the athletes are able to cope with their rotator cuff injuries.

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